BFA-5 DE 101 08 411
LCD-Display Panel

Description

The invention concerns an LCD-display panel in accord with the concept of Claim 1.

LCD-displays, in recent times, are being installed not only for small surfaced displays for use in PCs, measurement instruments and the like, but are being found in large panel displays such as are found in public transit services, in airports and in similar applications. In these cases, large surface LCD display panels are made out of a multiplicity of LCD-modules set side by side and above one another. The single LCD-display module possess in each case, a plurality of single, controllable pixel elements. In order to be able to control these pixel elements, control circuits are assigned to each LCD-module. Such circuits are normally installed in the edge areas of the LCD-display module. LCD-display panels of this type have been disclosed by DE 296 07 786 U1. The individual LCD-display modules have been made known by DE 42 09 072 A1. However, if the display modules disclosed by DE 42 09 072 A1 are placed next to and above one another, then dark, inactive stripes appear, in which no display is possible. In the case of the LCD-display panel of DE 296 07 786 U1 technology, the individual LCD-modules, however, were place within a framework, so that a cross-hatched pattern was formed. However, again, in the lines of the cross-hatching, no display could be made. Rather, what was optically created was an impression of a multiplicity of single displays, located side by side and above and below one another.

Using as a starting point, the LCD-display panel disclosed by DE 296 07 786 U1, it is the purpose of the present invention to create a composite LCD-display panel from a plurality of individual LCD-displays placed side by side and top and bottom from each other, in which, between the individual LCD-display modules nearly no passive surfaces remain.

The achievement of this purpose is carried out by the features of Claim 1.

10071105 . 020802

Because of the fact, that contiguous LCD-modules, in the edge zones, in which the control circuits are placed, overlap in the manner of shingles, the control circuits can be covered over, so that no passive surfaces continue to exist in the display surface. In order to prevent, that by means of the backlight apparatus, the control circuits cause dark shadows in the overlap zone, the two neighboring LCD-display modules in the overlap zone are not placed in immediate contact with one another, but exhibit a slight intervening distance therebetween. In the interstitial space so made, is placed a light deflecting element, or an illuminating element. By means of the light deflecting element, or by means of the illuminating element, the shadowing of the backlight caused by the control circuits is compensated for. In this way, in an observation of the LCD-display panel, no dark zones appear in the overlap areas. In the backlight apparatus, in the concept of the invention, is to be found means through which ambient light is diverted through the LCD-display panel.

In accord with a preferred embodiment, any of the following can be installed as illuminating elements: micro-LEDs, organic LEDs, light emitting polymers (LEPs -- Claim 2), or cold cathode fluorescent light emitters (Claim 3). The intensity of this illumination element is, in this function, so controlled, that the shadowing of the actual backlight is compensated for and in this way, upon observing the display, the overlap zone is not visible.

In accord with a preferred embodiment, light deflection means can be found in the form of films with a microstructure, that is, Fresnel lenses or micro prisms, or films with hologram structure can be employed (see Claim 4). By means of such films, the achievement is gained, that incident light falling in the lateral area of the overlap zone is turned to radiate forward, and so the second edge zone of the involved LCD-display module is lighted from the rear.

In accord with a preferred embodiment of the invention, based on Claim 5, the control circuits are placed in the first edge zone on a transparent carrying material, whereby, the shadowing of the backlight apparatus by opaque elements, such as the control circuits, is reduced in the over-lapping area. The advantageous embodiment in accord with Claim 6 serves the same purpose, in accord with which the control circuits are embedded in a transparent matrix, that is to say, they are encapsulated.

In another advantageous embodiment of the invention, following the precepts of Claim 7, the polarization filters employed in the LCD-display modules are not installed, as was the previous practice, up to the first edge zone, but rather the polarization filters extend themselves principally over the active display surface, that is to say, over the pixel elements of the respective LCD-display modules. Again, this measure reduces the darker areas, at least a portion of the backlight can diffuse through the conventionally used glass carrier in the polarization filter-free surfaces.

In a further advantageous embodiment of the invention, Claim 8 teaches that the individual LCD-display modules, are tilted or inclined in relation to the general display surface. In this manner, the offset which otherwise would be in evidence over the greater area, because of the shingled arrangement, is compensated for.

In accord with yet another advantageous embodiment of the invention, Claim 9 indicates that preferentially, square or quadrilateral shaped LCD-display modules are employed, whereby the first and the second edge zones are designed to lie opposite one another. On the two other edge zones of the square or rectangle, in which no control circuit is to be found, the LCD-display modules can be placed directly against one another by a joint whereby a nearly contiguous transition contact is provided. This arrangement is to be found in the alignment described in DE-OS 100 23 378.3. To this stated extent, full recognition of DE-OS 100 23 378.3 is taken.

As to further advantageous embodiments of the invention, as stated in Claims 10 and 11, the connection lines to the control circuits and to the illuminating element in the overlap areas, are in the form of transparent, ribbon conductors. Also, by this means, the shadowing of the backlight is diminished.

Further details, features, and advantages of the invention are provided by the following description of a preferred embodiment with the aid of the drawing.

There is shown in:

Fig. 1 an example embodiment of the invention in top view,

Fig. 2 a top view on an individual LCD-display module,

Fig. 3 a cross-sectional view along the line A-A of Fig. 2

Fig. 4 a partial view along the line B-B of Fig. 1

Fig. 5 a detail view of the overlap zone between two LCD-display modules with an overlap illuminating element therebetween,

Fig. 6 a detailed presentation of the overlap zone between two LCD-display modules with a light diverter in between and

Fig. 7a a schematic cross-section presentation, which shows the inclination of
Fig. 7b individual LCD-display modules in relation to the LCD-panel.

Fig. 1 shows a top view of an embodiment example of the invention, in the case of an LCD-display panel, in accord with the present invention, wherein a total of nine LCD-display modules 2-1 to 2-9 are combined. In this embodiment are respectively three LCD-display modules placed in three contiguous vertical rows, wherein, in each row, respectively, two of the vertically disposed LCD-display modules overlap, forming at each juncture an overlap zone. The side by side LCD-display modules, that is 2-1 and 2-4, have a joint between them. Each rectangular shaped LCD-display module 2 possesses a first and a second edge zone, designated respectively 4 and 6, which lie at opposite sides of the rectangular shape. That is to say, in the orientation of the embodiment in Fig. 1, the first edge zone is found below while on the opposite side, i.e., the second edge zone, is located above. The first edge zone 4 of the first LCD-display module 2-1 is covered over by the second edge zone 6 of the second LCD-display module 2-2, so that the first edge zone 4 of the first LCD-display module 2-1 and the second edge zone 6 of the second LCD-display module 2-2 form in common an overlay zone 3. In the same manner, the first edge zone 4 of the second LCD-display module 2-2 is likewise covered over by the second edge zone 6 of the third LCD-display module 2-3. The first edge zone 4 of the third LCD-display module 2-3 is covered by a frame 8. The frame 8 peripherally encloses the entire display panel with all nine LCD-display modules 2. The placement of the LCD-display module 2-1 to 2-3 repeats itself for the LCD-display modules 2-4 to 2-6 and likewise, 2-7 to 2-9. The holding together of the vertically and horizontally neighboring LCD-display modules is furnished by a transparent, applied matrix, not described in further detail, which is provided in the area of the joints of the adjacently situated LCD-display modules 2.

Fig 2 depicts an individual LCD-display module 2 in plan view and Fig. 3 presents a section along the line A-A in Fig. 2. The first edge zone 4 is placed below and the

second edge zone 6 is placed above. On the first edge zone 4 a plurality of control circuits 10 is arranged, which, by means of a multiplicity of connecting lines (not shown) are connected with a corresponding multiplicity of pixel elements 12. The pixel elements first extend themselves in the form of a set of columns and rows over the same surface of the LCD-display module 2 with the exception of the first edge zone 4. On the lateral edges 14, LCD-display modules 2, lying next to one another, are placed against a jointing, so that a horizontal, unbroken display surface is formed.

Fig. 3 shows, that the LCD-display module 2 includes a transparent, first carrier plate 16 and a transparent, second carrier plate 18, between which a liquid crystal 20 is encapsulated. In this arrangement, the second carrier plate 18 is somewhat larger and hence extends beyond the first carrier plate 16 into the first edge zone 4. In the first edge zone 4 are located the control circuits 10 and are embedded in an transparent matrix 22.

As may be seen in Fig. 4, behind the LCD-display modules 2, a backlight apparatus is installed, which comprises a plurality of illumination elements 26. In this arrangement, for each LCD-display module 2, one illuminating element 26 is assigned. Those LCD-display modules 2 which overlap, are separated from one another in the overlap zone 3 by a distance d. In the interstitial space caused by the overlap, is placed an overlap light element 30, or a passive light deflection element 32. By means of the overlap light element 30 or by means of the said light deflection element 32, the shadowing produced by the backlight 24 being blocked by the opaque control circuit in the first edge zone 4 of the LCD-display modules 2 is compensated for. The reference number 33 denotes beams of light, which, originating in the backlight apparatus 24, come from behind and penetrate the individual LCD-display modules 2.

Figs. 5 and 6 provide detail views of the overlap zone 3, whereby in the case of the embodiment according to Fig. 5, micro-LEDs are provided as illumination elements 30 in the overlap zone 3 between the LCD-display modules 2, while where the embodiment according to Fig. 6 is concerned, a microstructured film is employed as a light deflection element 32.

By means of the micro-LEDs 30, the second edge zone 6 of the respective LCD-display module 2 is additionally illuminated and the partial shadowing of the backlight apparatus 24, caused by the control circuit 10 and the lines therefrom, is compensated for.

10071607.020802

This compensation is shown by means of the depiction of light beams 34. Instead of the micro-LEDs 30, it is possible, for this service, to employ organic LEDs (OLED), light emitting polymers (LEP) or cold cathode fluorescent lamps. Also other light emitting active materials are possible which can be installed within the confined breadth of the separation in the overlap zone. The current supply and the control of the overlap illuminating element 30 is carried out by means of a transparent, ribbon conductor 35. The use of a transparent material, such as, for example, polyester or polycarbonate, instead of a Kapton^{R} polyimide diminishes the said shadowing of the backlight apparatus 24.

Fig. 6 shows, schematically, a film with a microstructure as a light deflector element 32. The light is incident from the side of the film 32 and is diverted forward on the second edge zone 6 of the respective LCD-display module 2-i. For example, incoming light beams 36 falling on the side are diverted forward through the second edge zone 6. At the same time, the light beams 33 penetrate the transparent matrix 22 in the first edge zone 4 and backlight LCD-display module in the first edge zone 4.

Films, which are appropriate for light deflection 32 were marketed by the firm 3M under the trademark Vikuiti. The kind and the thickness of the film are so chosen, that the shadowing of the backlight apparatus 24 by means of the control circuits 10 is compensated for. The change of direction of the light can be achieved by micro-prisms or by Fresnel lenses. Instead of the microstructure, another possibility is the use of correspondingly designed hologram films for light deflection.

In the case of the LCD-display modules 2, polarization filters (not shown) are placed before and after the liquid crystal 20. The LCD-display modules can be operated in the NW-mode (Normally White, transparent at no voltage) or in the NB-mode (Normally Black; dark at no voltage). So that no undesirable shadowing of the backlight apparatus 24 occurs, the filmlike polarization filters are so dimensioned, that they only cover over the active display areas of the LCD-display module 2.

Figs. 7a and 7b show, again schematically, sectional views, from which may be inferred, that the individual LCD-display modules 2 are slightly inclined in relation to the entire LCD-display panel. This inclination is marked by an acute angle α in relation to the entire LCD-display panel.

10021235.012502

Fig. 7a shows an arrangement of LCD-display modules, in which the first edge zone is below, and Fig. 7b, conversely, the arrangement places the first edge zone 4 respectively above. The backlight apparatus 24 in the Figs. 7a and 7b (not shown) would be placed, in Figs. 7a, 7b, respectively to the left of the sectional presentation of the LCD-display modules shown.

By means of the said inclination of the LCD-display modules 2, it is prevented, that by the overlapping of the individual LCD-display modules 2 an offset is accumulated from the top to the bottom. The angle α lies in a range between 1 and 10° The arrangement in accord with Figs. 7a, 7b is especially important in the case of LCD-panels of large areas.

* * *

Reference Numbers and Items

2	LCD-display module
3	Overlap zone
4	First edge zone
6	Second edge zone
8	Framing for panel
10	Control circuit
12	Pixel element
14	Edges at side
16	First carrier plate
18	Second carrier plate
20	Liquid crystal
22	Transparent matrix
24	Backlight apparatus (general)
26	Backlight Illuminating element
30	Overlap light element
32	Light deflector
33	Light beam from 26
34	Light beam from 30 or 32
35	Transparent, ribbon conductor
36	Incident, angular light beams (from 33 or ambient)
40	Display area
α	Angle of inclination (Fig. 7)

* * *

BFA-5 DE 101 08 411

LCD-Display Panel

Summary

An LCD-display panel is proposed, which is comprised of a plurality of LCD-display modules (2) arranged beside one another and neighboring each other at top and bottom, wherein two LCD-display modules (2) immediately adjacent to one another are placed in an overlap zone (3) and over lap one another somewhat in the manner of shingles. In this way, in a first edge zone (4) the control circuit (10) of each LCD-display module (2) is covered. Between the two LCD-display modules (2), is placed an overlap illumination element (30) or a light deflection means (32), which compensates for the shadowing effects of the circuits (10) on the backlight apparatus (24).

* * *

20080205 . 50710700